NOTES ON THE FEEDING AND BREEDING HABITS OF SAPERDA TRIDENTATA OLIV.

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While working on the scolytid beetles involved in the Dutch elm disease problem, the writer was able to secure considerable incidental information on the habits of other species attacking elm, although usually little time was available to conduct well controlled experiments with any of them. However, so little is known about the common and economically important elm borer *Saperda tridentata,* that it was thought advisable to present an abstract of the information secured about this species over a period of several years in southeastern New York. For the sake of brevity no reference will be made to the natural enemies of this species as that has been well covered by other workers.

In southeastern New York the first adults of *S. tridentata* appear in early May. Most of the emergence takes place the last week in May and the first week in June with an occasional straggler appearing until mid-July. The males always appear first from a given lot of material; for the first several days the emergence is usually wholly males, but females begin to appear in gradually increasing numbers until only females are found. The total number of each sex appearing from a lot of material is about equal.

In spite of the abundance of this species in certain areas, it is rarely encountered in the field during the day. It is most active at night and during the day secretes itself on the bark or among the foliage. Both sexes are often taken at lights at night.

Mating takes place soon after emergence and eggs may be laid three or four days after emergence. Before egg laying takes place the adults feed on the leaves, leaf petioles, or young twigs of elms in the vicinity. Such feeding may sometimes be quite extensive; the larger veins of the leaves are usually eaten and large holes may be chewed in the surrounding tissue; on the twigs and petioles the feeding is usually less noticeable as usually only the outer layer of tissue is destroyed. Sometimes, however, twigs are so nearly gnawed through that they break and fall or dangle by a strip of bark.

Since feeding by the adults is of primary importance from a standpoint of the transmission of the Dutch elm disease fungus, the writer attempted to determine whether such feeding is absolutely necessary for egg laying. In 1937 freshly cut elm logs were selected and sawed into shorter lengths, alternate sections being placed in the same cage. Adult male and female *S. tridentata* from a single

source were secured and equal numbers of each were placed in the various rearing cages. In one set of cages fresh elm leaves and twigs were added and renewed at frequent intervals; in the other set no leaves or twigs were added. The insects fed extensively where food was provided and in all cases laid large numbers of eggs which produced normal larvae. Where no food was provided no eggs were laid. This experiment was done with two sets of cages in 1937 and was repeated with two more sets in 1938 and in no case were eggs laid where no food was present and in every case eggs were laid where fresh leaves were available. It is interesting to note in this connection that where no food was provided the insects were short lived, rarely living for more than a week; when allowed to feed the adults frequently lived from one to nearly two months.

In order to substantiate the above experiments, adult females of *S. tridentata* which had emerged from one lot of elm wood on June 10, 1938, were divided into two lots and placed at a constant temperature of 20° C. on June 11. Each insect was placed in a separate container and fresh elm leaves placed in half of the containers. Insects from each set of containers were killed and dissected at regular intervals. A few well developed eggs were found on June 14 in those that had been allowed to feed, and every specimen examined subsequently until June 24 when the experiment was discontinued had from four to twenty-four well developed eggs. Unfed specimens never developed eggs and all were dead by June 18,

Oviposition usually takes place at night. The egg slits are made in crevices in the bark; the slits may frequently be close together but only one egg is laid in each slit. The total number of eggs laid may vary considerably depending on the size and longevity of the female. Most of the individuals studied lived about a month under normal outdoor conditions and laid from fifty to sixty eggs during this period.

Fresh sappy wood is usually selected for oviposition. Freshly cut logs and weakened trees are especially susceptible to the attacks of *S. tridentata.* Probably perfectly healthy trees are not attacked although some workers think that they are. There is no doubt, however, that trees which externally show no weakened condition are frequently attacked by *S. tridentata,* the first sign of its presence being the thinning and dropping of the foliage followed by the dying of a branch or two. Such trees although apparently vigorous, are probably suffering from a food or water deficiency or possible root injury. Leaking gas mains in the vicinity may reduce the vitality of the tree sufficiently to make it susceptible to *S. tridentata* attack. However, once established in a generally debilitated tree or in an isolated branch suffering from some injury,

the larvae may spread to the healthy portion of the tree. Under such circumstances the upper branches are usually killed first resulting in the stag-headed appearance so commonly seen, and the insects gradually work downward over a period of several generations until the whole tree is dead. When a tree suddenly begins to die from some other cause, all portions are attacked simultaneously from the trunk to branches only a few inches thick.

Immediately after hatching the young larva begins to tunnel transversely across the grain of the wood between the bark and wood. The young larva by its transverse tunneling frequently girdles the branch in which it is working. As the larva matures its tunnels meander in all directions reducing the inner bark and outer sapwood to a mass of granular frass. The tunnels form shallow channels in the sap wood and in fresh, moist wood may be almost wholly restricted to the inner bark. The writer has never found tunnels penetrating below the surface of the wood except in the construction of the pupal cell. By the time the larvae are well grown, large pieces of loosened bark may be easily striped from the tree.

From early August to mid-October most of the larvae begin the construction of pupal cells in which they will remain over winter and transform to pupae and adults the following spring. The pupal cell is usually constructed five or six mm. below the surface of the wood (exclusive of bark) and parallel with the grain. After the cell is completed the larva reverses its position so that it faces the opening by which it entered. This opening it plugs with fibrous frass. The larva usually makes no provision for the escape of the adult by gnawing an opening in the bark above the entrance to the pupal cell as is the case in some other members of the genus; it is occasionally done, however. Usually a certain percentage of the larvae construct an oval pupal cell between the bark and wood or, in thick barked trees, wholly in the bark.

In southeastern New York the first pupae are found in late April and early May. The length of the pupal period varies considerably. The first adults to appear in May have a pupal period of twenty-two to thirty-three days with an average of about twenty-four to twenty-seven days; adults appearing in June have a pupal period averaging from fifteen to eighteen days.

After transforming to an adult, *S. tridentata* may remain in the pupal cell as long as a week. The normal colors of the adult are attained and hardening of the integument takes place during the first twenty-four to forty-eight hours of this period. Emergence may or may not be by way of the frass filled tunnel leading to the

pupal cell. Frequently the adult will gnaw an entirely new tunnel through the wood and bark or utilize only part of the larval entrance tunnel.

In sawed wood the adult often emerges through the end of the log if the pupal cell is within one half to three quarters of an inch of the end. Emergence is probably at least partly a response to outside temperatures and the adult takes the shortest possible route to the surface, apparently being guided by the temperature at the log surface. The emergence hole is somewhat oval and varies greatly in size, most of them being about 4 by $4\frac{1}{2}$ mm. in diameter.

There is normally one generation a year, but individuals in wood that has dried out rapidly may take two or three years to complete their development. Even larvae from the same group of eggs may take one, two, or even three years to complete their development under conditions which are apparently identical. The writer has found no individual that required more than three years or less than one year to complete its development. On the other hand occasional individuals of the cerambycids *Neoclytus acuminatus* and *Xylotrechus colonus,* which are frequently associated with *S. tridentata,* develop from egg to adult in three to four months.

Larvae hatching from eggs laid in July and August by late emerging stragglers or especially long lived individuals, usually require two seasons to complete their development, but frequently a few individuals will emerge with the main *S. tridentata* emergence the following spring. It might be expected that adults derived from late laid eggs would emerge late the following season but apparently this is not the case; either they appear with the usual spring emergence or require an additional year to complete their life cycle.

Several workers have mentioned that three sizes of larvae are frequently found together in galleries and take this as presumptive evidence that the life cycle is probably three years, each size of larvae representing a distinct generation. It is extremely doubtful if *S. tridentata* will attack the same portions of a tree for three or even two years in succession as not only is fresh material preferred, but the first group of larvae would probably manage to consume most of the available food the first year. Since the writer has observed great variation in the size of *S. tridentata* larvae of the same age and even from the same lot of eggs, it is doubtful if the above mentioned observations on larval sizes are of much significance.